

Claims

1. A cascaded Raman laser comprising:
 - a) a pump radiation source emitting at a pump wavelength λ_p ,
 - b) an input section and an output section made of an optical medium, each section comprising wavelength selectors for wavelengths $\lambda_1, \lambda_2, \dots, \lambda_{n-k}$, where $n \geq 3$, $\lambda_p < \lambda_1 < \lambda_2 < \dots < \lambda_{n-1} < \lambda_n$ and $\lambda_{n-k+1}, \lambda_{n-k+2}, \dots, \lambda_n$ being $k \geq 1$ emitting wavelengths of the laser, and
 - c) an intracavity section that is made of a non-linear optical medium, has a zero-dispersion wavelength λ_0 and is disposed between the input and the output section,

wherein

- d) the wavelengths $\lambda_1, \lambda_2, \dots, \lambda_{n-k}$ of the wavelength selectors and the zero-dispersion wavelength λ_0 of the intracavity section are chosen such that energy is transferred between radiation of different wavelengths by multi-wave mixing.

2. The laser of claim 1, wherein at least one of the emitting wavelengths λ_{n-k+1} , λ_{n-k+2} , ..., λ_n of the laser is involved in multi-wave mixing.
3. The laser of claim 1, wherein the wavelengths λ_1 , λ_2 , ..., λ_{n-k} of the wavelengths selectors are chosen so that energy transfer by multi-wave mixing involves at least three adjacent wavelengths.
4. The laser of claim 3, wherein the wavelengths λ_1 , λ_2 , ..., λ_{n-1} of the wavelength selectors are chosen so that

$$1/\lambda_i = 1/\lambda_{i-1} + 1/\lambda_{i-2} - 1/\lambda_{i-3} ,$$

where $i = 3, 4, \dots, n$, and that the zero-dispersion wavelength λ_0 of the intracavity section substantially equals $(\lambda_{i-1} + \lambda_{i-2})/2$.

5. The laser of claim 3, wherein the wavelengths λ_1 , λ_2 , ..., λ_{n-k} of the wavelengths selectors are chosen so that

$$1/\lambda_i = 2/\lambda_{i-1} - 1/\lambda_{i-2} ,$$

where $i = 3, 4, \dots, n$, and that the zero-dispersion wavelength λ_0 of the intracavity section substantially equals λ_{i-1} .

6. The laser of claim 1, wherein the wavelengths λ_1 , λ_2 , ..., λ_{n-k} of the wavelengths selectors are chosen so that energy transfer by multi-wave mixing involves at least three non-adjacent wavelengths.

7. The laser of claim 6, wherein $k = 2$ and that the wavelengths $\lambda_1, \lambda_2, \dots, \lambda_{n-2}$ of the wavelengths selectors are chosen so that

$$1/\lambda_i = 1/\lambda_{i-2} + 1/\lambda_{i-3} - 1/\lambda_{i-5}$$

and

$$1/\lambda_{i-1} = 1/\lambda_{i-2} + 1/\lambda_{i-3} - 1/\lambda_{i-4} ,$$

where $i = 5, 6, \dots, n$, and that the zero-dispersion wavelength λ_0 of the intracavity section substantially equals $(\lambda_{i-2} + \lambda_{i-3})/2$.

8. The laser of claim 6, wherein $k = 2$ and that the wavelengths $\lambda_1, \lambda_2, \dots, \lambda_{n-1}$ of the wavelengths selectors are chosen so that

$$1/\lambda_i = 2/\lambda_{i-2} - 1/\lambda_{i-4}$$

and

$$1/\lambda_{i-1} = 2/\lambda_{i-2} - 1/\lambda_{i-3} ,$$

where $i = 5, 6, \dots, n$, and that the zero-dispersion wavelength λ_0 of the intracavity section substantially equals λ_{i-2} .

9. The laser of claim 1, wherein for each emitting wavelength an additional wavelength selector for wavelength $\lambda_{n-k+1}, \lambda_{n-k+2}, \dots, \lambda_n$, respectively, is provided in the input section (14) and in the output section.

10. The laser of claim 1, wherein the wavelength selectors are reflectors having center wavelengths $\lambda_1, \lambda_2, \dots, \lambda_{n-k}$.